

Author: Jan Walleckec  
Category: Trustee Memos  
Date: April 23, 2020

This file captures an image of the Fetzer Franklin Fund website at [www.fetzerfranklinfund.org](http://www.fetzerfranklinfund.org) as of May, 2020. Each file in this library contains the content from a different section of the website. The Fetzer Franklin Fund has been operated by the Fetzer Memorial Trust since its inception in 2005, with the support of the Fetzer Institute. The inspiration of this science program stemmed from the vision of John E. Fetzer, who wrote

“I feel that we are on the threshold of a new order where people will be seeking enlightened change. ... This will all come about with the infusion of spirituality into science. The Foundation’s eventual intent is to integrate the scientific process with spiritual mindedness ... A fundamental key to all this is to conduct this search with a proper line of scientific investigation.”

In the last ten years, Fetzer Franklin led breakthroughs in the following areas:

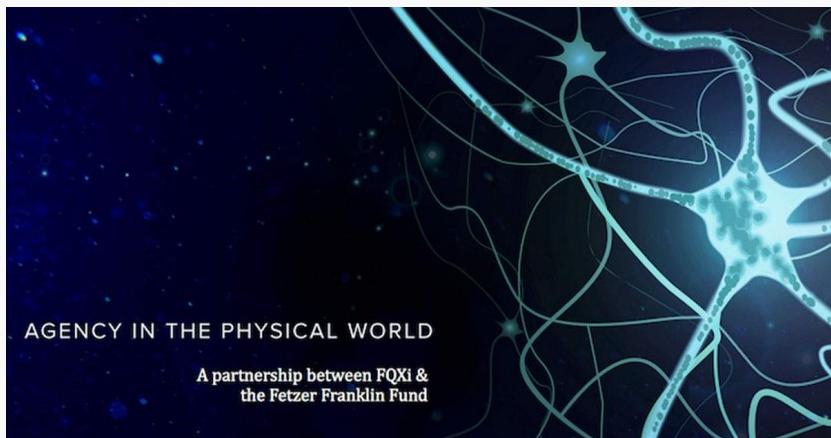
- 1 Relational Reality – the concept of the interconnection of all things at the quantum level now exists within mainstream physics academies in the world.
- 2 Metascience – the scientific study of the scientific method is a high priority for most major funding institutions in the world.
- 3 Advanced Protocols to study anomalous phenomena are becoming accepted. This could present an opportunity to advance mainstream investigation of extreme possibilities in the area of psi and subtle energy research. Psi, energy medicine, and subtle energy were dominant interests of John Fetzer. These revolutionary advanced protocols could help discern real effects from false positive effects which would catalyze substantial interest in these fields.

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## NEWS

**24/12/2019**

### 2019 INTELLIGENCE IN THE PHYSICAL WORLD – WINNERS ANNOUNCED



The 'Intelligence in the Physical World' program is part of a science strategic partnership between the Fetzer Franklin Fund of the John E. Fetzer Memorial Trust and FQXi. This partnership funds work on Agency, Intelligence, and Consciousness. This is the second RFP supported by this partnership.

The PIs listed were selected by a grant review panel and then recommended for funding through a donor-advised fund at the Silicon Valley Community Foundation.

Nine projects will share US\$1.5million. Congratulations to all the winners and all those who took part!

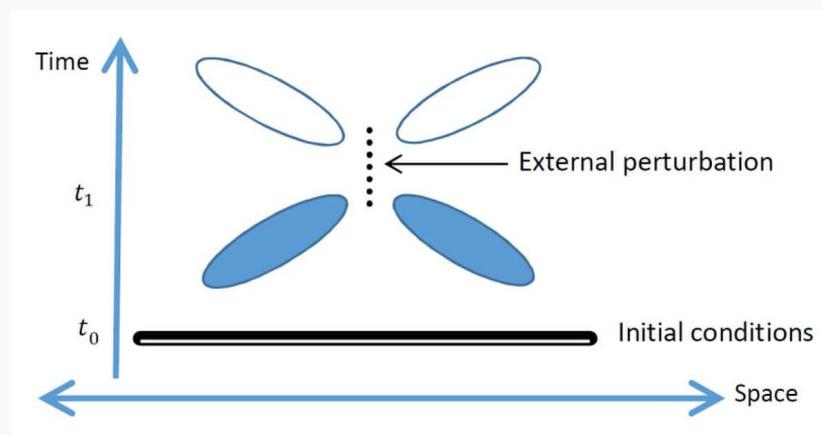
**Go to [fqxi.org](http://fqxi.org) to see the full winners list.**

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## NEWS

24/09/2018

### A LENIENT CAUSAL ARROW OF TIME?



One of the basic assumptions underlying Bell's theorem is the causal arrow of time, having to do with temporal order rather than spatial separation. Nonetheless, the physical assumptions regarding causality are seldom studied in this context, and often even go unmentioned, in stark contrast with the many different possible locality conditions which have been studied and elaborated upon. In the present work, some retrocausal toy-models which reproduce the predictions of quantum mechanics for Bell-type correlations are reviewed. It is pointed out that a certain toy-model which is ostensibly superdeterministic—based on denying the free-variable status of some of quantum mechanics' input parameters—actually contains within it a complete retrocausal toy-model. Occam's razor thus indicates that the superdeterministic point of view is superfluous. A challenge is to generalize the retrocausal toy-models to a full theory—a reformulation of quantum mechanics—in which the standard causal arrow of time would be replaced by a more lenient one: an arrow of time applicable only to macroscopically-available information. In discussing such a reformulation, one finds that many of the perplexing features of quantum mechanics could arise naturally, especially in the context of stochastic theories.

[View Full-Text / Download Paper](#)

By [Nathan Argaman](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

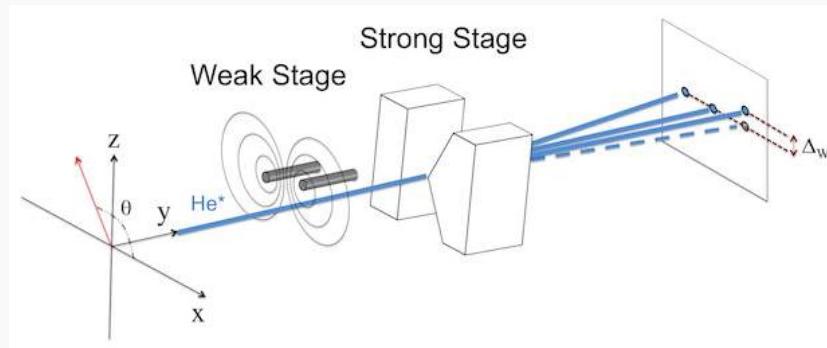
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## NEWS

22/08/2018

### A METHOD FOR MEASURING THE WEAK VALUE OF SPIN FOR METASTABLE ATOMS



A method for measuring the weak value of spin for atoms is proposed using a variant of the original Stern-Gerlach apparatus. A full simulation of an experiment for observing the real part of the weak value using the impulsive approximation has been carried out. Our predictions show a displacement of the beam of helium atoms in the metastable  $23S1$  state,  $\Delta_w$ , that is within the resolution of conventional microchannel plate detectors indicating that this type of experiment is feasible. The analysis of Robert Flack, Vincenzo Monachello, Basil Hiley and Peter Barker also determines the experimental parameters that will give an accurate determination of the weak value of spin. Preliminary experimental results are shown for helium, neon and argon in the  $23S1$  and  $3P2$  metastable states, respectively. [View Full-Text](#) / [Download Paper](#)

By [Robert Flack](#), [Vincenzo Monachello](#), [Basil Hiley](#) and [Peter Barker](#)

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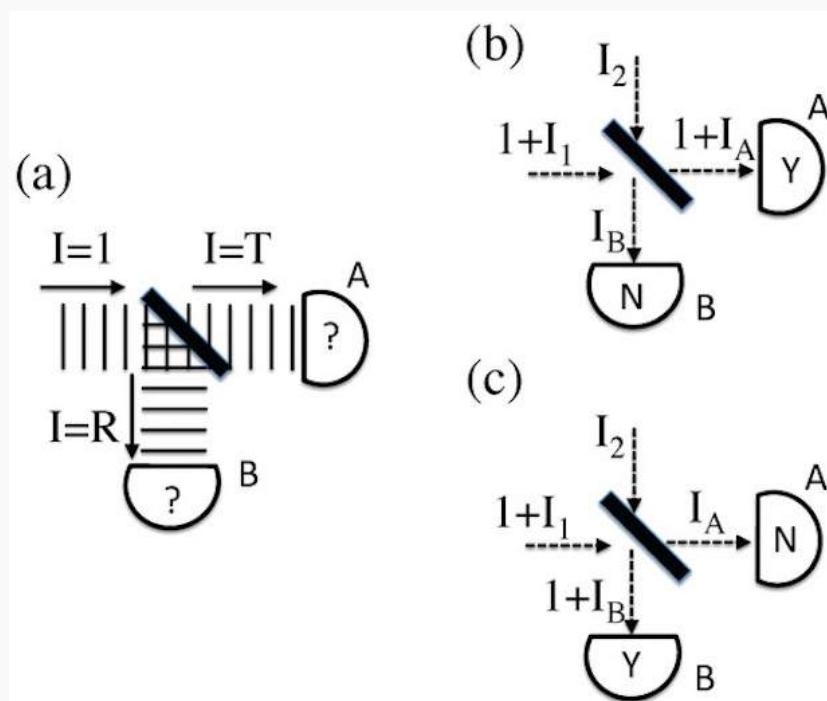
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## NEWS

18/09/2018

### A NEW CLASS OF RETROCAUSAL MODELS



Globally-constrained classical fields provide a unexplored framework for modeling quantum phenomena, including apparent particle-like behavior. By allowing controllable constraints on unknown past fields, these models are retrocausal but not retro-signaling, respecting the conventional block universe viewpoint of classical spacetime. Several example models are developed that resolve the most essential problems with using classical electromagnetic fields to explain single-photon phenomena. These models share some similarities with Stochastic Electrodynamics, but without the infinite background energy problem, and with a clear path to explaining entanglement phenomena. Intriguingly, the average intermediate field intensities share a surprising connection with quantum "weak values", even in the single-photon limit. This new class of models is hoped to guide further research into spacetime-based accounts of weak values, entanglement, and other quantum phenomena. [View Text](#) / [Download Paper](#)

By [Ken Wharton](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

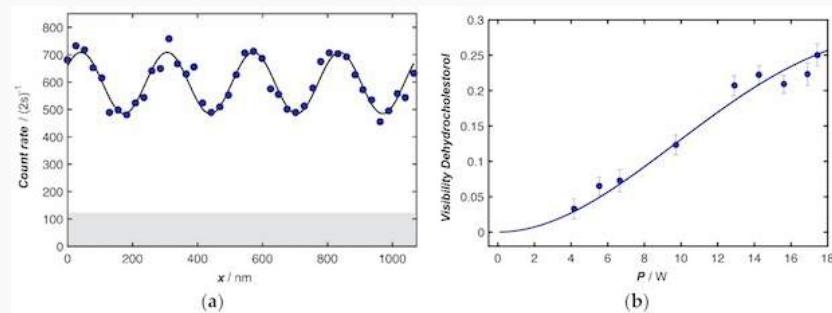
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## NEWS

25/08/2018

### A QUANTUM RULER FOR MAGNETIC DEFLECTOMETRY



Matter-wave near-field interference can imprint a nano-scale fringe pattern onto a molecular beam, which allows observing its shifts in the presence of even very small external forces. Here we demonstrate quantum interference of the pre-vitamin 7-dehydrocholesterol and discuss the conceptual challenges of magnetic deflectometry in a near-field interferometer as a tool to explore photochemical processes within molecules whose center of mass is quantum delocalized. [View Full-Text](#) / [Download Paper](#)

By Lukas Mairhofer, Sandra Eibenberger, Armin Shayeghi and Markus Arndt

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

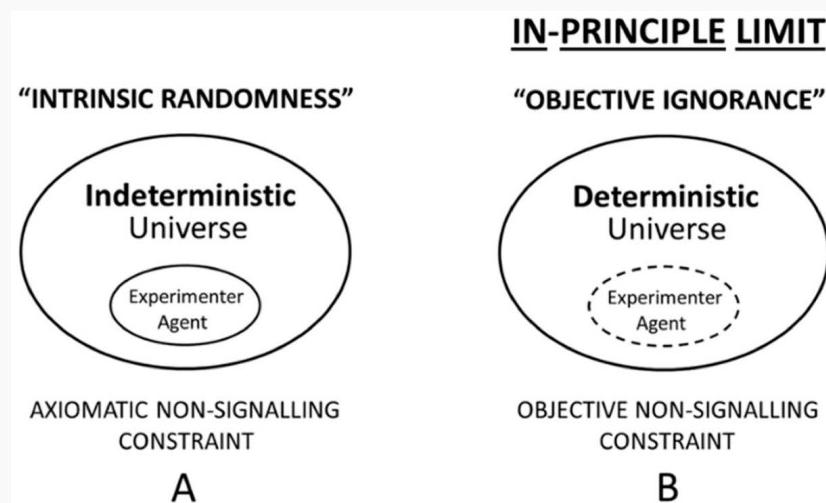
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## NEWS

04/02/2019

### AGENT INACCESSIBILITY AS A FUNDAMENTAL PRINCIPLE IN QUANTUM MECHANICS: OBJECTIVE UNPREDICTABILITY AND FORMAL UNCOMPUTABILITY



The inaccessibility to the experimenter agent of the complete quantum state is well-known. However, decisive answers are still missing for the following question: What underpins and governs the physics of agent inaccessibility? Specifically, how does nature prevent the agent from accessing, predicting, and controlling, individual quantum measurement outcomes? The orthodox interpretation of quantum mechanics employs the metaphysical assumption of indeterminism—‘intrinsic randomness’—as an axiomatic, in-principle limit on agent-quantum access. By contrast, ontological and deterministic interpretations of quantum mechanics typically adopt an operational, in-practice limit on agent access and knowledge—‘effective ignorance’. The present work considers a third option—‘objective ignorance’: an in-principle limit for ontological quantum mechanics based upon self-referential dynamics, including undecidable dynamics and dynamical chaos, employing uncomputability as a formal limit. Given a typical quantum random sequence, no formal proof is available for the truth of quantum indeterminism, whereas a formal proof for the uncomputability of the quantum random sequence—as a fundamental limit on agent access ensuring objective unpredictability—is a plausible option. This forms the basis of the present proposal for an agent-inaccessibility principle in quantum mechanics.

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**By Jan Walleczek**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

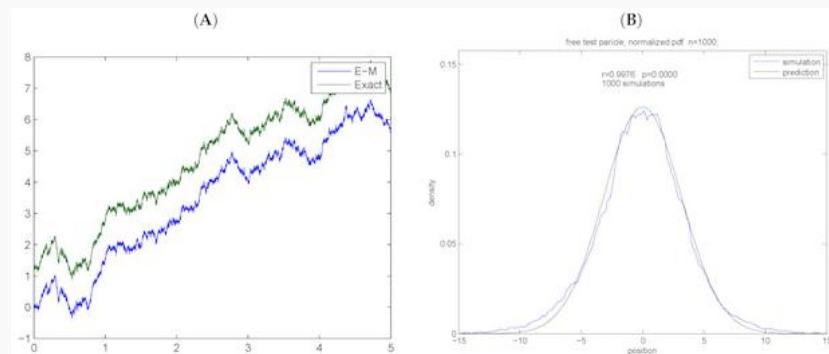
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## NEWS

30/08/2018

### ANALYTICAL AND NUMERICAL TREATMENTS OF CONSERVATIVE DIFFUSIONS AND THE BURGERS EQUATION



The present work is concerned with the study of a generalized Langevin equation and its link to the physical theories of statistical mechanics and scale relativity. It is demonstrated that the form of the coefficients of the Langevin equation depends critically on the assumption of continuity of the reconstructed trajectory. This in turn demands for the fluctuations of the diffusion term to be discontinuous in time. This paper further investigates the connection between the scale-relativistic and stochastic mechanics approaches, respectively, with the study of the Burgers equation, which in this case appears as a stochastic geodesic equation for the drift. By further demanding time reversibility of the drift, the Langevin equation can also describe equivalent quantum-mechanical systems in a path-wise manner. The resulting statistical description obeys the Fokker-Planck equation of the probability density of the differential system, which can be readily estimated from simulations of the random paths. Based on the Fokker-Planck formalism, a new derivation of the transient probability densities is presented. Finally, stochastic simulations are compared to the theoretical results. [View Full-Text / Download Paper](#)

By Dimitar Prodanov

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

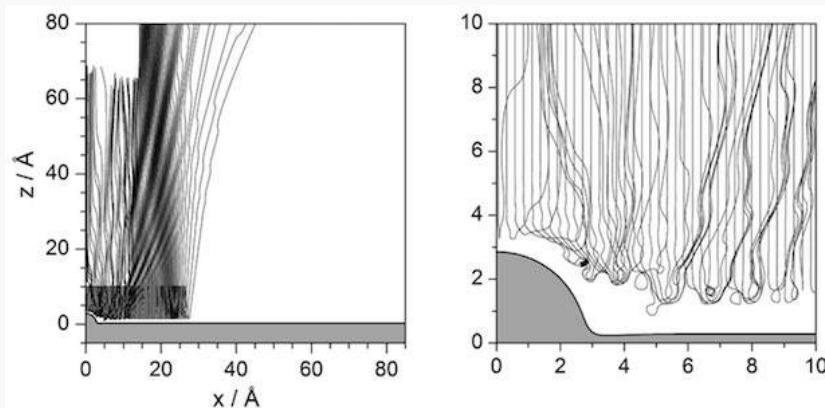
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## NEWS

13/09/2018

### ATOM-DIFFRACTION FROM SURFACES WITH DEFECTS: A FERMATIAN, NEWTONIAN AND BOHMIAN JOINT VIEW



Bohmian mechanics, widely known within the field of the quantum foundations, has been a quite useful resource for computational and interpretive purposes in a wide variety of practical problems. Here, it is used to establish a comparative analysis at different levels of approximation in the problem of the diffraction of helium atoms from a substrate consisting of a defect with axial symmetry on top of a flat surface. The motivation behind this work is to determine which aspects of one level survive in the next level of refinement and, therefore, to get a better idea of what we usually denote as quantum-classical correspondence. To this end, first a quantum treatment of the problem is performed with both an approximated hard-wall model and then with a realistic interaction potential model. The interpretation and explanation of the features displayed by the corresponding diffraction intensity patterns is then revisited with a series of trajectory-based approaches: Fermatian trajectories (optical rays), Newtonian trajectories and Bohmian trajectories. As it is seen, while Fermatian and Newtonian trajectories show some similarities, Bohmian trajectories behave quite differently due to their implicit non-classicality. [View Full-Text](#) / [Download Paper](#)

By [Ángel S. Sanz](#)

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[Back to News](#)**NEWS****26/03/2019****BRAIN INSTITUTE RECEIVES OVER \$7 MILLION TO STUDY THE NEUROPHILOSOPHY OF FREE WILL**

The newly-minted Institute for Interdisciplinary Brain and Behavioral Science (The Brain Institute) at Chapman University, with Dr. Uri Maoz as project leader, is the recipient of a total of \$7.04 million to study how the human brain enables conscious control of decisions and actions. The John Templeton Foundation funded \$5.34 million; the Fetzer Institute funded \$1.55 million; and the remaining \$150,000 comes from the Fetzer Memorial Trust. This is Chapman's largest non-federal research grant to date. With the Chapman Brain Institute serving as the central hub, this grant supports research efforts at 17 universities spanning four continents, including Charité Berlin (Germany), Dartmouth, Duke, Florida State University, Harvard, Indiana University Bloomington, NIH, Monash University (Australia), NYU, Sigtuna (Sweden), Tel Aviv University (Israel), University College London (UK), University of Edinburgh (UK), UCLA and Yale. The project launched at an international conference on the Neuroscience of Free Will that the Brain Institute and Crean College of Health and Behavioral Sciences at Chapman University hosted in mid-March.

"We were pleased to establish Chapman's Brain Institute and to bring the faculty associated with it to Chapman University last year," said Daniele Struppa, Ph.D., Chapman University president. "Their approach to research reflects Chapman's goal of combining research with teaching and involving undergraduate and graduate students at all levels in the process. We are grateful for this grant from the Templeton Foundation and the Fetzer Institute, which recognizes Chapman as a leader in this developing field."

"This grant aims to create a new field in the study of the brain--the neurophilosophy of free will," said Uri Maoz, Ph.D., assistant professor of psychology and computational neuroscience at Chapman University. "The extent and scope of human free will has been debated by philosophers for millennia. In recent decades, neuroscientists have joined the discussion, leading to some interesting discoveries. The current project, however, represents a four-year effort forging structured, close collaborations on these questions between eight neuroscientists (including Dr. Aaron Schurger, assistant professor of psychology, the latest faculty recruit to the Brain Institute at Chapman) and nine philosophers from around the world. Hopefully, in 10 years we will look back at the grant and say that's where it all started," said Dr. Maoz.

"This large-scale investment, by the John Templeton Foundation and the Fetzer Institute, comes to the Brain Institute even before its official launch next month," said Amir Raz, Ph.D., Chapman University professor of psychology and brain sciences and director of the Brain Institute. "Work at the Brain Institute addresses fundamental questions of human experience: do we have free will? Are we, in fact, free to do what we wish? What is the role of consciousness in our decisions? We are grateful for the opportunities the combined grant offers as well as the testament it provides to confidence in our work."

"The Templeton Foundation and Fetzer Institute grant acknowledge that consequential, complex questions find answers only when approached through the lenses of multiple disciplines and their research techniques," said Janeen Hill, Ph.D., dean of Crean College. "Chapman University and Crean College's commitment to brain science and its inherent interdisciplinarity is reinforced by the significance of this combined grant."

Entitled "Consciousness and Free Will: A Joint Neuroscientific-Philosophical Investigation," the grant aims to advance efforts in the neurophilosophy of free will. For example, researchers at the Brain Institute and their collaborators will use advanced analysis techniques of brain activity and strive to decode decisions and actions before they take place. Or they will use various techniques to compare human brain activity when people make arbitrary decisions (e.g., when asked to randomly raise their left or right hand) and deliberate ones (e.g., when asked to raise their left or right hand to donate to one charity or another).

"This grant, placing Chapman as a leader in neuroscience, reflects our deepening commitment to research and to academic excellence," said Glenn Pfeiffer, Ph.D., provost of Chapman University. "This announcement comes soon after the recent elevation of Chapman University to Carnegie Classification R2, signifying 'high research activity.' We have never been stronger as a research institution than we are right now."

"In fact," said Thomas Piechota, Ph.D., PE, vice president of research, "this is an opportune time to partner with Chapman University. The research being conducted by the Brain Institute and throughout Chapman is exciting and innovative. Our faculty are exemplary researchers and the involvement of students of every level - including first-year undergraduates - is a fundamental part of the personalized education that we offer."

Hosted at the Rinker Health Science campus in Irvine, as well as on the Orange campus, the Brain Institute comprises a network of interdisciplinary researchers who conduct empirical investigations into the cognitive neuroscience of altered planes of consciousness, neuropsychology, volition, formal models of higher brain functions among other fields. Our work draws on clinical populations, healthy volunteers, and innovations in artificial intelligence, machine learning, and big data.

"Questions about consciousness and free will are of enduring interest in both philosophy and the sciences. This project will feature field-leading researchers on these two topics, using rigorous and collaborative methods to advance our understanding of both of them. It is therefore a perfect fit for the John Templeton Foundation, and we are pleased to support Chapman in this initiative," said John Churchill, director of philosophy and theology programs at the John Templeton Foundation.

"We are drawn to this work because of its cutting-edge exploration of free will, the breadth of the research effort Chapman University has developed, and the scale of this major funding collaboration with Templeton," said Mohammed Mohammed, Fetzer Institute program director of research, discovery, and development. "We are excited about this venture into the intersection of philosophy and neuroscience."

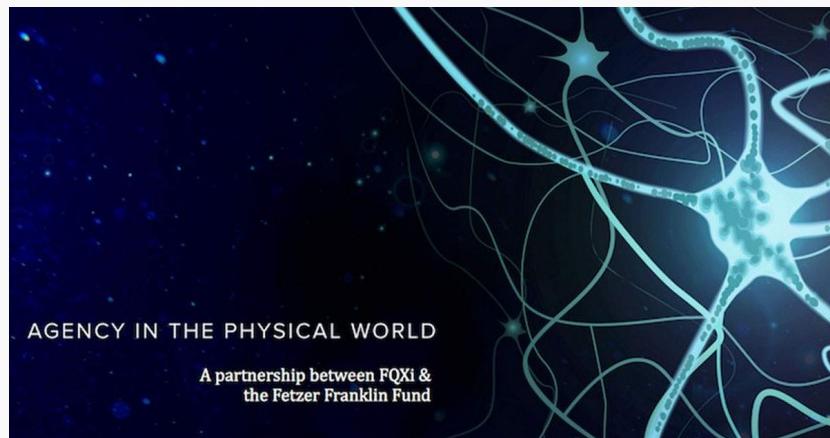
Original post: [eurekalert.org](http://eurekalert.org)

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## NEWS

**22/01/2020**

### CONSCIOUSNESS IN THE PHYSICAL WORLD (REQUEST FOR PROPOSALS) IS OPEN!



Fetzer Franklin Fund and FQXi announce the Consciousness in the Physical World RFP open to initial applications through February 12, 2020 (11:59PM Eastern Standard Time).

The initial application must include:

- A 300-500 word summary of the project, explicitly addressing why it is topical, foundational and unconventional
- A draft budget with description not exceeding 200 words, including an approximate total cost over the life of the award and explanation of how funds would be spent
- A Curriculum Vitae for each Principal Investigator, which MUST be in PDF format, each including:
  - Education and employment history
  - A list of up to five previous publications relevant to the proposed research and up to five additional representative publications
  - Full publication list

A review panel assembled by FQXi will screen each Initial Proposal according to the criteria in Section III. Based on their assessment, the applicant may be invited to submit a Full Proposal, around March 2020, perhaps with feedback on improving the proposal.

Please keep in mind that however positive FQXi or FFF personnel may be about a proposal at any stage, it may still be turned down for funding after full peer review.

For more information (FAQ, Examples, Application Form, Timeline) please go to <https://fqxi.org/grants/large/initial>

[Back to News](#)**NEWS**

18/04/2018

**EMILY ADLAM'S INTERVIEW WITH GEORGE MUSSER  
(VIDEO)**

George Musser: "Usually when physicists talk about nonlocality, they mean spatial nonlocality— influences leaping across the void. But if Einstein taught us nothing else, it is that space and time are woven together. So if there is spatial nonlocality, there should also be temporal nonlocality— influences leaping across spans of time, explains theoretical physicist Emily Adlam, who just received her Ph.D. from the University of Cambridge."



For more, see <http://spookyactionbook.com/2018/03/27/an-interview-with-emily-adlam-video/>

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## NEWS

22/11/2017

### EMQM17 WAS A GREAT SUCCESS



About 350 registered attendees made the EmQM17 London symposium a great success. A strong case was made for the possibility of ontological quantum mechanics on the occasion of the David Bohm Centennial celebration at Senate House of the University of London, adjacent to Birkbeck College, Prof. Bohm's final academic home.

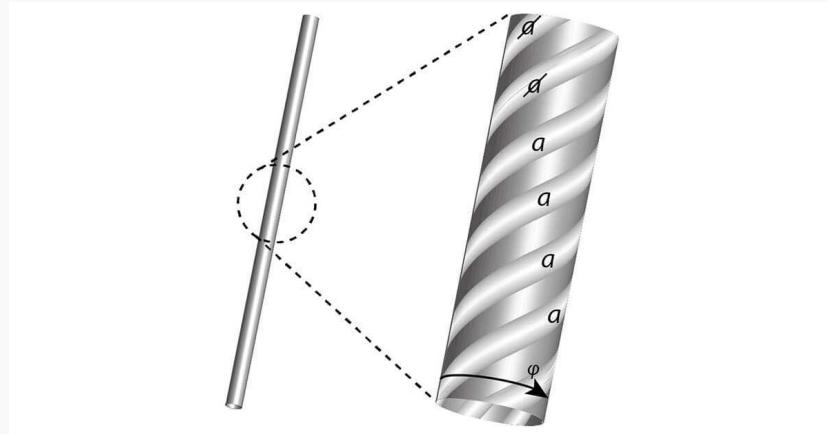
For the **speakers**, the **scientific program**, and the **photo gallery** documenting the event go to [emqm17.org](http://emqm17.org).

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## NEWS

**21/09/2018**

### EXPERIMENTAL NON-VIOLATION OF THE BELL INEQUALITY



A finite non-classical framework for qubit physics is described that challenges the conclusion that the Bell Inequality has been shown to have been violated experimentally, even approximately. This framework postulates the primacy of a fractal-like 'invariant set' geometry IU in cosmological state space, on which the universe evolves deterministically and causally, and from which space-time and the laws of physics in space-time are emergent. Consistent with the assumed primacy of IU, a non-Euclidean (and hence non-classical) metric  $g_p$  is defined in cosmological state space. Here,  $p$  is a large but finite integer (whose inverse may reflect the weakness of gravity). Points that do not lie on IU are necessarily  $g_p$ -distant from points that do.  $g_p$  is related to the  $p$ -adic metric of number theory. Using number-theoretic properties of spherical triangles, the Clauser-Horne-Shimony-Holt (CHSH) inequality, whose violation would rule out local realism, is shown to be undefined in this framework. Moreover, the CHSH-like inequalities violated experimentally are shown to be  $g_p$ -distant from the CHSH inequality. This result fails in the singular limit  $p=\infty$ , at which  $g_p$  is Euclidean and the corresponding model classical. Although Invariant Set Theory is deterministic and locally causal, it is not conspiratorial and does not compromise experimenter free will. The relationship between Invariant Set Theory, Bohmian Theory, The Cellular Automaton Interpretation of Quantum Theory and  $p$ -adic Quantum Theory is discussed. [View Full-Text](#) / [Download Paper](#)

By [T. N. Palmer](#)

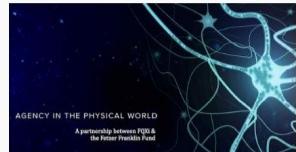
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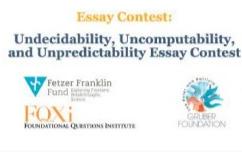
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**NEWS**

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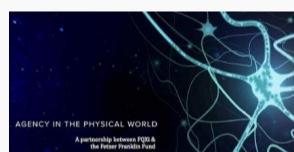
[Show more !\[\]\(9cc80862e225935f5e2ce39495f8c582\_img.jpg\)](#)**UNDECIDABILITY, UNCOMPUTABILITY, AND UNPREDICTABILITY - NEW ESSAY CONTEST**

Fetzer Franklin Fund and FQXi announce the Undecidability, Uncomputability, and Unpredictability Essay Contest open to submissions through March 16, 2020.

For a brief time in history, it was possible to imagine that a sufficiently advanced intellect

[Show more !\[\]\(e1d91f75f04404f4dc129e6dbe94982e\_img.jpg\)](#)**13/01/2020****CONFERENCE: THE SCIENCE OF CONSCIOUSNESS 2020 (TUCSON, ARIZONA, USA)**

'The Science of Consciousness' ('TSC') is the world's largest and longest-running interdisciplinary conference addressing fundamental questions regarding consciousness, the brain, reality and existence.

[Show more !\[\]\(797008f668b861bc39af9103e66d0e26\_img.jpg\)](#)**24/12/2019****2019 INTELLIGENCE IN THE PHYSICAL WORLD – WINNERS ANNOUNCED**

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[Show more !\[\]\(15490c495bd89543a068b88bc7519185\_img.jpg\)](#)**04/12/2019****METASCIENCE 2019 PROPOSAL WINNERS!**

Congratulations to the Metascience 2019 proposal winners!

Submissions were evaluated blind to researcher identities, and all proposals meeting the quality threshold were included in a lottery for final selection.

[Show more !\[\]\(b016e2f97f5b6fa0849628c4d64e1007\_img.jpg\)](#)**03/11/2019****METASCIENCE: THE SCIENCE OF DOING SCIENCE**

*Cover story by Jonathan Schooler in Association for Psychological Science. Observer Volume 32, Issue 9, November 2019.*

The field of metascience has gained increasing momentum in recent years as concerns about

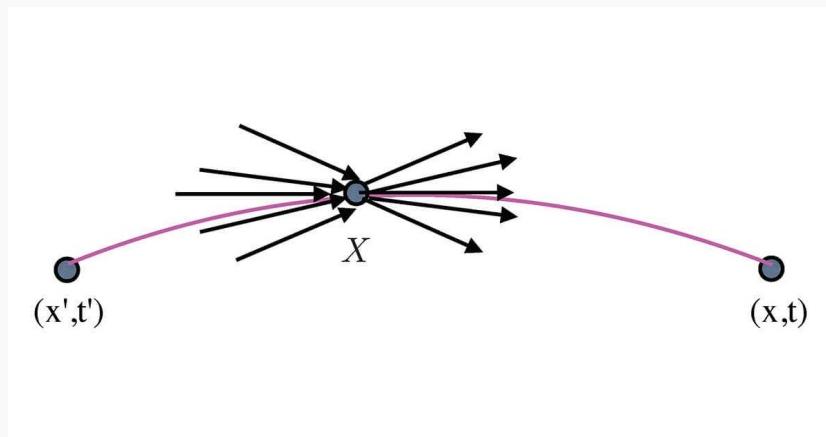
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## NEWS

22/09/2018

### FEYNMAN PATHS AND WEAK VALUES



There has been a recent revival of interest in the notion of a 'trajectory' of a quantum particle. In this paper, we detail the relationship between Dirac's ideas, Feynman paths and the Bohm approach. The key to the relationship is the weak value of the momentum which Feynman calls a transition probability amplitude. With this identification we are able to conclude that a Bohm 'trajectory' is the average of an ensemble of actual individual stochastic Feynman paths. This implies that they can be interpreted as the mean momentum flow of a set of individual quantum processes and not the path of an individual particle. This enables us to give a clearer account of the experimental two-slit results of Kocsis et al. [View Full-Text](#) / [Download Paper](#)

By [Robert Flack](#) and [Basil J. Hiley](#)

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## NEWS

27/08/2018

### FUNDAMENTAL IRREVERSIBILITY: PLANCKIAN OR SCHRÖDINGER-NEWTON?

11<sup>10</sup> Aharonov: A szobája, ahol itásztala működik, nem hárítózott, nem papírharcott. 50 évenél lehet maximum, olvastam teljesen megőt, hiszen vannak rivárt rövid időben is epp telefonál, de leülhet. David Bohmöt is láttam, majd megszimatettem, mivel ő is. Addig elmesélhetem a kvantumgravitációs rejtélyeket. Körben beállt azonban Bohm, ő legalább a 60-as évek tapasztalatai lehetőleg 70 is. Ez hallgatni, Aharonov általában meggyőzően meggyőzi Bohm-ot, hogy a superstringet magyarázza Bohm-nak, szaki állandóban viszont elutasítja. A végrinnek is közel a lárcs véleménye, Bohm-nak is hasonló a véleménye. Aharonov viszont a részt vevők, de előtte pár ismeretlen, jól, elmondja Bohm-ot, amit addig az nem hallhatott. Aharonovnak nem tetszik a gravitációs zaj, ő dinamikát szeretné, de a végen a master-equationt is a fizika állapot reprezentációjának. Egyet megfoghatta őt. Nagyon jól érte a környezetet, igencsak határozottan és összefoglalóan valamint folyamatosan beszél.

13<sup>30</sup> Először ismertetem a Schrödinger-Newton modellről (localizáció, + orthog.) Péntek körül majd Peresher számonra elbocsátunk.

The concept of universal gravity-related irreversibility began in quantum cosmology. The ultimate reason for universal irreversibility is thought to come from black holes close to the Planck scale. Quantum state reductions, unrelated to gravity or relativity but related to measurement devices, are completely different instances of irreversibilities. However, an intricate relationship between Newton gravity and quantized matter might result in fundamental and spontaneous quantum state reduction—in the non-relativistic Schrödinger-Newton context. The above two concepts of fundamental irreversibility emerged and evolved with few or even no interactions. The purpose here is to draw a parallel between the two approaches first, and to ask rather than answer the question: can both the Planckian and the Schrödinger-Newton indeterminacies/irreversibilities be two faces of the same universe. A related personal note of the author's 1986 meeting with Aharonov and Bohm is appended. [View Full-Text](#) / [Download Paper](#)

By Lajos Diósi

*This abstract belongs to an article of the Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"*

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## NEWS

24/09/2018

### GENERALIZED LAGRANGIAN PATH APPROACH TO MANIFESTLY-COVARIANT QUANTUM GRAVITY THEORY

Useful implications of the GLP-representation in Equations (53)–(54) follow by inspection of the GLP-quantum continuity equation (see first equation in Equation (57)) obtained above. The first one follows by noting that the same equation implies also

$$\frac{D}{Ds} \ln \rho(G_L(s), \Delta g, s) = -\frac{\partial V_{\mu\nu}(G_L(s), \Delta g, s)}{\partial g_{L\mu\nu}(s)}, \quad (62)$$

so that its formal integration generates the map  $\rho(G_L(s_o), \Delta g, s_o) \rightarrow \rho(G_L(s), \Delta g, s)$ , with  $\rho(G_L(s), \Delta g, s)$  denoting the proper-time evolved quantum PDF, namely

$$\rho(G_L(s), \Delta g, s) = \rho(G_L(s_o), \Delta g, s_o) \exp \left\{ - \int_{s_o}^s ds' \frac{\partial V_{\mu\nu}(G_L(s'), \Delta g, s')}{\partial g_{L\mu\nu}(s')} \right\}. \quad (63)$$

A trajectory-based representation for the quantum theory of the gravitational field is formulated. This is achieved in terms of a covariant Generalized Lagrangian-Path (GLP) approach which relies on a suitable statistical representation of Bohmian Lagrangian trajectories, referred to here as GLP-representation. The result is established in the framework of the manifestly-covariant quantum gravity theory (CQG-theory) proposed recently and the related CQG-wave equation advancing in proper-time the quantum state associated with massive gravitons. Generally non-stationary analytical solutions for the CQG-wave equation with non-vanishing cosmological constant are determined in such a framework, which exhibit Gaussian-like probability densities that are non-dispersive in proper-time. As a remarkable outcome of the theory achieved by implementing these analytical solutions, the existence of an emergent gravity phenomenon is proven to hold. Accordingly, it is shown that a mean-field background space-time metric tensor can be expressed in terms of a suitable statistical average of stochastic fluctuations of the quantum gravitational field whose quantum-wave dynamics is described by GLP trajectories. [View Full-Text](#) / [Download Paper](#)

By Massimo Tessarotto and Claudio Cremaschini

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

30/05/2017

### INSTITUTE OF QUANTUM STUDIES RECEIVES DISTINGUISHED COZZARELLI PRIZE



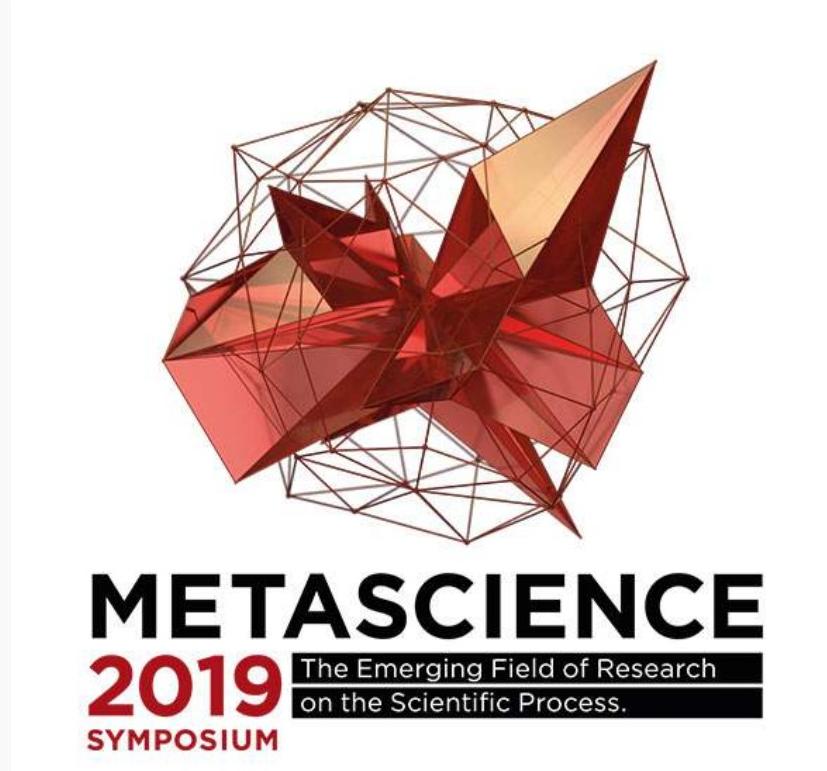
The Cozzarelli Prize of the US National Academy of Science has been awarded to a project of the Institute of Quantum Studies, which is led by [Yakir Aharonov](#) and [Jeff Tollaksen](#), at Chapman University, California. The Cozzarelli Prize is awarded annually for published PNAS papers "of outstanding scientific excellence and originality." The winners were recognized during the National Academy of Sciences Annual Meeting Awards Ceremony on April 30, 2017, in Washington, D.C. Chapman acknowledges support (in part) for this project by the [Fetzer Franklin Fund](#) of the John E. Fetzer Memorial Trust. The photo shows two members of the team who received the prestigious award at the ceremony, [Jeff Tollaksen](#) (right) and [Sandu Popescu](#) (left).

For the detailed story please go to:

<https://blogs.chapman.edu/press-room/2017/03/02/chapman-university-institute-for-quantum-studies-paper-receives-distinguished-cozzarelli-prize/>

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04/12/2019

**METASCIENCE 2019 PROPOSAL WINNERS!**

Congratulations to the Metascience 2019 proposal winners!

Submissions were evaluated blind to researcher identities, and all proposals meeting the quality threshold were included in a lottery for final selection.

- **Ye Sun; University of Utah**
- **Lanu Kim; Stanford University**
- **Shoshana Jarvis; University of California, Berkeley**
- **Timothy M. Errington; Center for Open Science**
- **Sean Grant; Indiana University, Richard M. Fairbanks School of Public Health**
- **Oskar Sebastian Lundmark; University of Gothenburg, Sweden**
- **Jelte M. Wickerts; Tilburg University**
- **Nicholas Devito; University of Oxford**
- **Aurélien Allard; University of California, Davis**
- **Charles Twardy; KeyW, a Jacobs Company**
- **Nicholas Otis; University of California, Berkeley**
- **Simine Vazire; University of California, Davis**
- **Kathleen Vohs; University of Minnesota**
- **Thomas Pfeiffer; Massey University**
- **Daniel Hamilton; The University of Melbourne, Australia**
- **Maya Mathur; Stanford University**
- **Olavo B. Amaral; University of Rio de Janeiro**
- **Julia G. Bottesini; University of California, Davis**
- **William Medley Thompson; Karolinska Institute**
- **Katherine S. Corker; Grand Valley State University**
- **Leoni Tiokhin, Eindhoven University of Technology**
- **Maia Salholz-Hilel; Universitätsmedizin Berlin**
- **Olmo van den Akker; Tilburg University**
- **Leonardo Tozzi; Stanford University**
- **Tobias Heycke; GESIS - Leibniz Institute for the Social Sciences**
- **William Gunn; Elsevier**
- **Zoltan Kekecs; ELTE (Eotvos Lorand University), Budapest, Hungary**
- **Robert S. Danziger; University of Melbourne**
- **Michael C. Frank; Stanford University**
- **Matthew Goodwin; Northeastern University**
- **Tim Parker, Whitman College**

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## NEWS

**03/11/2019**

### METASCIENCE: THE SCIENCE OF DOING SCIENCE

*Cover story by Jonathan Schooler in Association for Psychological Science.  
Observer Volume 32, Issue 9, November 2019.*

The field of metascience has gained increasing momentum in recent years as concerns about research reproducibility have fueled a larger vision of how the lens of science can be directed toward the scientific process itself. Metascience, also known as metaresearch or the science of science, attempts to use quantifiable scientific methods to elucidate how science works and why it sometimes fails. (...)

In September, a symposium on metascience ([metascience2019.org](http://metascience2019.org)), funded by the Fetzer Franklin Fund and held at Stanford University, brought together nearly 500 attendees to help consolidate the field. The symposium included over 50 speakers from a remarkable variety of scientific disciplines, including psychology, philosophy, biology, sociology, network science, economics informatics, quantitative methodology, history, statistics, political science, medicine, business, and chemical and biological engineering.

>> Read the full article on [www.psychologicalscience.org](http://www.psychologicalscience.org)

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## NEWS

27/01/2016

### NEW SCIENTIST MAGAZINE ON THE EmQM15 VIENNA SYMPOSIUM



"Is quantum physics a stepping stone to a deeper understanding of reality?" asks Michael Brooks in his report on the Vienna Symposium, which was published on November 14, 2015, in New Scientist magazine. The Vienna Quantum Symposium was sponsored by the Fetzer Franklin Fund (FFF) and its major purpose was to explore whether there could - in fact - exist "pre-existing connections between all quantum particles": Is the world local or nonlocal? A radically holistic conception of quantum reality was first envisioned in de Broglie-Bohm theory in the 1950s, the best-known alternative formulation of quantum mechanics.

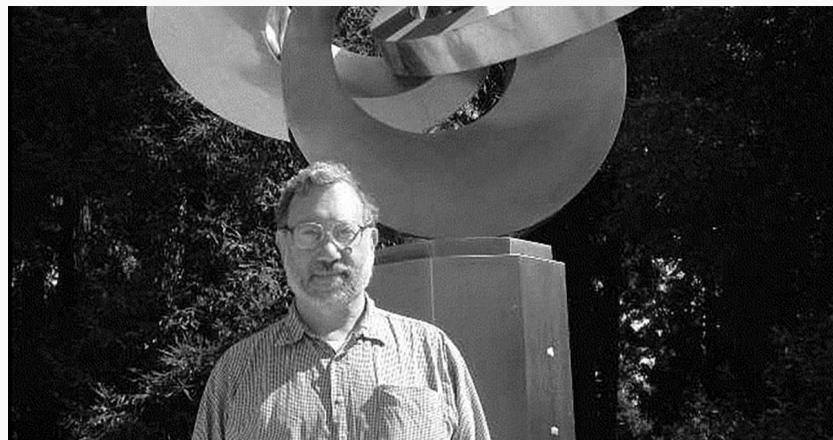
The report by Michael Brooks features statements by EmQM15 presenters also, including by Aephraim Steinberg (Univ. Toronto, Canada), Lev Vaidman (Tel Aviv Univ., Israel), Markus Arndt (Univ. Vienna, Austria), Nobel Laureate Gerard 't Hooft (Utrecht Univ., Netherlands), Howard Wiseman (Griffith Univ., Australia), and Jan Walczek (FFF and Phenoscience Laboratories, Berlin, Germany). For more information about the EmQM15 Symposium see the Events section on this website or go to [www.emqm15.org](http://www.emqm15.org). For the article go to: [www.newscientist.com](http://www.newscientist.com).

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## NEWS

**01/09/2018**

### NON-COMMUTATIVE WORLDS AND CLASSICAL CONSTRAINTS



This paper reviews results about discrete physics and non-commutative worlds and explores further the structure and consequences of constraints linking classical calculus and discrete calculus formulated via commutators. In particular, we review how the formalism of generalized non-commutative electromagnetism follows from a first order constraint and how, via the Kilmister equation, relationships with general relativity follow from a second order constraint. It is remarkable that a second order constraint, based on interlacing the commutative and non-commutative worlds, leads to an equivalent tensor equation at the pole of geodesic coordinates for general relativity. [View Full-Text](#) / [Download Paper](#)

**By Louis H. Kauffman**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

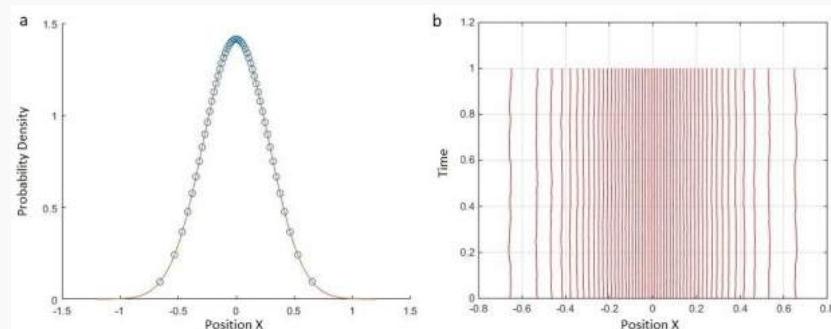
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## NEWS

20/08/2018

### NONLOCALITY IN BELL'S THEOREM, IN BOHM'S THEORY, AND IN MANY INTERACTING WORLDS THEORIZING



"Locality" is a fraught word, even within the restricted context of Bell's theorem. As one of us has argued elsewhere, that is partly because Bell himself used the word with different meanings at different stages in his career. The original, weaker, meaning for locality was in his 1964 theorem: that the choice of setting by one party could never affect the outcome of a measurement performed by a distant second party. The epitome of a quantum theory violating this weak notion of locality (and hence exhibiting a strong form of nonlocality) is Bohmian mechanics. Recently, a new approach to quantum mechanics, inspired by Bohmian mechanics, has been proposed: Many Interacting Worlds. While it is conceptually clear how the interaction between worlds can enable this strong nonlocality, technical problems in the theory have thus far prevented a proof by simulation. Ghadimi, Hall and Wiseman report significant progress in tackling one of the most basic difficulties that needs to be overcome: correctly modelling wavefunctions with nodes. [View Full-Text](#) / [Download Paper](#)

By Mojtaba Ghadimi, Michael J. W. Hall and [Howard M. Wiseman](#)

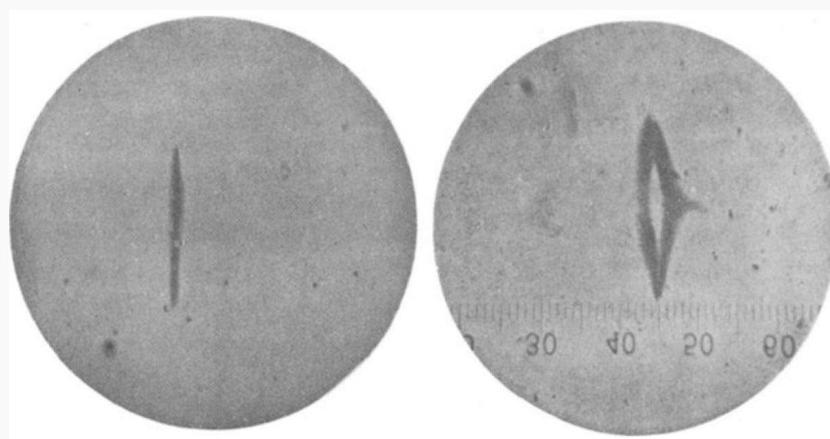
*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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20/09/2018

## OBSERVABLES AND UNOBSERVABLES IN QUANTUM MECHANICS: HOW THE NO-HIDDEN-VARIABLES THEOREMS SUPPORT THE BOHMIAN PARTICLE ONTOLOGY



The paper argues that far from challenging—or even refuting—Bohm’s quantum theory, the no-hidden-variables theorems in fact support the Bohmian ontology for quantum mechanics. The reason is that (i) all measurements come down to position measurements; and (ii) Bohm’s theory provides a clear and coherent explanation of the measurement outcome statistics based on an ontology of particle positions, a law for their evolution and a probability measure linked with that law. What the no-hidden-variables theorems teach us is that (i) one cannot infer the properties that the physical systems possess from observables; and that (ii) measurements, being an interaction like other interactions, change the state of the measured system. [View Full-Text](#) / [Download Paper](#)

**By Dustin Lazarovici, Andrea Oldofredi and Michael Esfeld**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

10/09/2018

### ON A COMMON MISCONCEPTION REGARDING THE DE BROGLIE–BOHM THEORY

We discuss a common misconception regarding the de Broglie–Bohm (dBB) theory; namely, that it not only assigns a position to each quantum object but also contains the momenta as “hidden variables”. Sometimes this alleged property of the theory is even used to argue that the dBB theory is inconsistent with quantum theory. We explain why this claim is unfounded and show in particular how this misconception veils the true novelty of the dBB theory. [View Full-Text](#) / [Download Paper](#)

By Oliver Passon

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

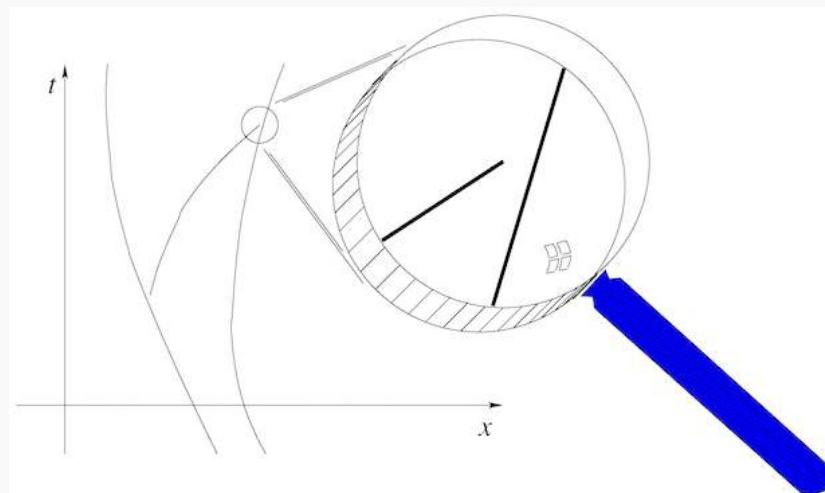
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## NEWS

07/09/2018

### ON BOHMIAN MECHANICS, PARTICLE CREATION, AND RELATIVISTIC SPACE-TIME: HAPPY 100TH BIRTHDAY, DAVID BOHM!



The biggest and most lasting among David Bohm's (1917-1992) many achievements is to have proposed a picture of reality that explains the empirical rules of quantum mechanics. This picture, known as pilot wave theory or Bohmian mechanics among other names, is still the simplest and most convincing explanation available. According to this theory, electrons are point particles in the literal sense and move along trajectories governed by Bohm's equation of motion. In this paper, I describe some more recent developments and extensions of Bohmian mechanics, concerning in particular relativistic space-time and particle creation and annihilation. [View Full-Text](#) / [Download Paper](#)

By [Roderich Tumulka](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

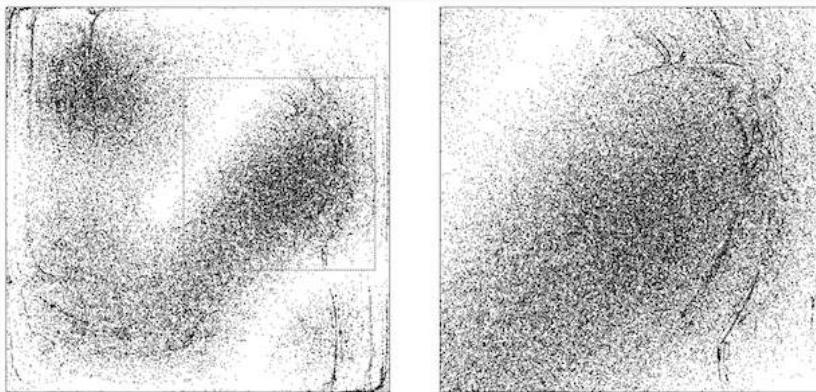
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## NEWS

17/09/2018

### ON THE EXPLANATION OF BORN-RULE STATISTICS IN THE DE BROGLIE-BOHM PILOT-WAVE THEORY



The de Broglie-Bohm pilot-wave theory promises not only a realistic description of the microscopic world (in particular, a description in which observers and observation play no fundamental role) but also the ability to derive and explain aspects of the quantum formalism that are, instead, (awkwardly and problematically) postulated in orthodox versions of quantum theory. Chief among these are the various "measurement axioms" and in particular the Born rule expressing the probability distribution of measurement outcomes. Compared to other candidate non-orthodox quantum theories, the pilot-wave theory suffers from something of an embarrassment of riches in regard to explaining the Born rule statistics, in the sense that there exist, in the literature, not just one but two rather compelling proposed explanations. This paper is an attempt to critically review and clarify these two competing arguments. We summarize both arguments and also survey some objections that have been given against them. In the end, we suggest that there is somewhat less conflict between the two approaches than existing polemics might suggest, and that indeed elements from both arguments may be combined to provide a unified and fully-compelling explanation, from the postulated dynamical first principles, of the Born rule. [View Full-Text](#) / [Download Paper](#)

**By Travis Norsen**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

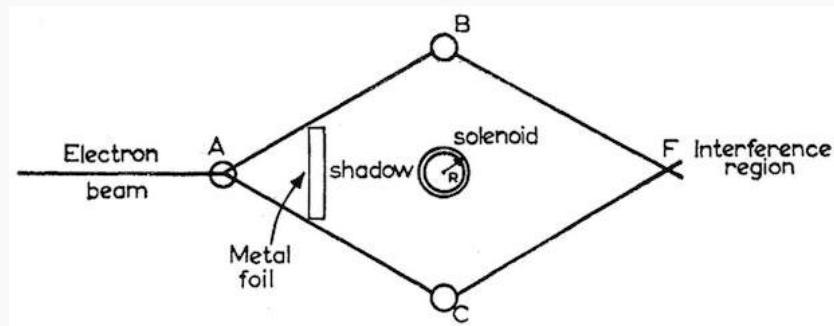
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## NEWS

05/09/2018

### ONTOLOGICAL CLARITY VIA CANONICAL PRESENTATION: ELECTROMAGNETISM AND THE AHARONOV–BOHM EFFECT



Quantum physics demands some radical revision of our fundamental beliefs about physical reality. We know that because there are certain verified physical phenomena—two-slit interference, the disappearance of interference upon monitoring, violations of Bell's inequality—that have no classical analogs. But the exact nature of that revision has been under dispute since the foundation of quantum theory. I offer a method of clarifying what the commitments of a clearly formulated physical theory are, and apply it to a discussion of some options available to account for another non-classical phenomenon: the Aharonov-Bohm effect. [View Full-Text](#) / [Download Paper](#)

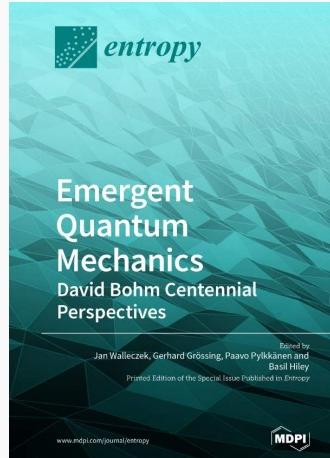
By [Tim Maudlin](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## PUBLICATIONS

### EMERGENT QUANTUM MECHANICS - DAVID BOHM CENTENNIAL PERSPECTIVES



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- Quantum Causality and Ontology
- Information Measures in Quantum Theory
- Quantum Observation and the Physics of the Experimenter Agent
- Nonlinear Methods applied to Quantum Theory
- Self-organization and Quantum Emergence
- Hidden Variable Theories and Relativity
- Emergent Space-time

ISBN 978-3-03897-616-5 (Pbk);

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Jan Walleczek, Gerhard Grössing, Paavo Pylkkänen and Basil Hiley  
(Eds.)

Pages: 544

Published: April 2019

**E**mergent quantum mechanics (EmQM) explores the possibility of an ontology for quantum mechanics. The resurgence of interest in realist approaches to quantum mechanics challenges the standard textbook view, which represents an operationalist approach. The possibility of an ontological, i.e., realist, quantum mechanics was first introduced with the original de Broglie-Bohm theory, which has also been developed in another context as Bohmian mechanics. This book features expert contributions which were invited as part of the [David Bohm Centennial symposium of the EmQM conference series](#). Questions directing the EmQM research agenda are: Is reality intrinsically random or fundamentally interconnected? Is the universe local or nonlocal? Might a radically new conception of reality include a form of quantum causality or quantum ontology? What is the role of the experimenter agent in ontological quantum mechanics? The book features research examining ontological propositions also that are not based on the Bohm-type nonlocality. These include, for example, local, yet time-symmetric, ontologies, such as quantum models based upon retrocausality. The book offers thirty-two contributions which are organized into seven categories to provide orientation as is outlined in the Editorial contribution in the beginning of the book.

This book is a printed edition of the Special Issue Emergent Quantum Mechanics - David Bohm Centennial Perspectives that was published in Entropy.

### EMQM17



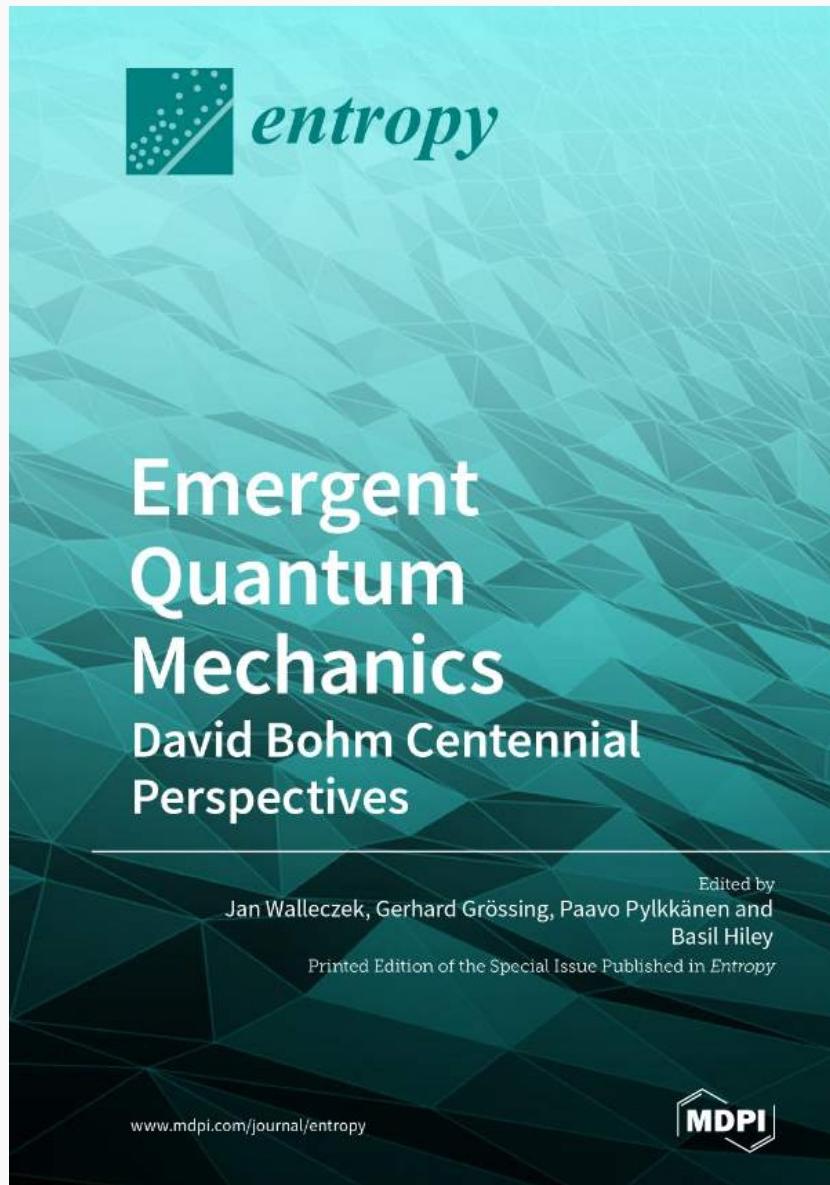
#### The publication is a result of the EmQM17 conference:

On the occasion of David Bohm's 100th birthday, a symposium on emergent quantum mechanics will be held at the University of London, Senate House, on October 26-28, 2017. This Special Issue features expert views that critically evaluate the prospects and significance—for 21st century physics—of ontological quantum mechanics, an approach which David Bohm helped pioneer.

Click [HERE](#) for more information.

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11/04/2019

**OUT NOW AND FREE TO DOWNLOAD: EMERGENT QUANTUM MECHANICS: DAVID BOHM CENTENNIAL PERSPECTIVES**

Emergent quantum mechanics (EmQM) explores the possibility of an ontology for quantum mechanics. The resurgence of interest in realist approaches to quantum mechanics challenges the standard textbook view, which represents an operationalist approach. The possibility of an ontological, i.e., realist, quantum mechanics was first introduced with the original de Broglie-Bohm theory, which has also been developed in another context as Bohmian mechanics. This book features expert contributions which were invited as part of the [David Bohm Centennial symposium](#) of the EmQM conference series. Questions directing the EmQM research agenda are:

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- What is the role of the experimenter agent in ontological quantum mechanics?

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For more information about the book "Emergent Quantum Mechanics: David Bohm Centennial Perspectives", [click here](#).

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14/09/2018

## QUANTUM THERMODYNAMICS AT STRONG COUPLING: OPERATOR THERMODYNAMIC FUNCTIONS AND RELATIONS



Identifying or constructing a fine-grained microscopic theory that will emerge under specific conditions to a known macroscopic theory is always a formidable challenge. Thermodynamics is perhaps one of the most powerful theories and best understood examples of emergence in physical sciences, which can be used for understanding the characteristics and mechanisms of emergent processes, both in terms of emergent structures and the emergent laws governing the effective or collective variables. Viewing quantum mechanics as an emergent theory requires a better understanding of all this. In this work we aim at a very modest goal, not quantum mechanics as thermodynamics, not yet, but the thermodynamics of quantum systems, or quantum thermodynamics. We will show why even with this minimal demand, there are many new issues which need be addressed and new rules formulated. The thermodynamics of small quantum many-body systems strongly coupled to a heat bath at low temperatures with non-Markovian behavior contains elements, such as quantum coherence, correlations, entanglement and fluctuations, that are not well recognized in traditional thermodynamics, built on large systems vanishingly weakly coupled to a non-dynamical reservoir. For quantum thermodynamics at strong coupling, one needs to reexamine the meaning of the thermodynamic functions, the viability of the thermodynamic relations and the validity of the thermodynamic laws anew. After a brief motivation, this paper starts with a short overview of the quantum formulation based on Gelin & Thoss and Seifert. We then provide a quantum formulation of Jarzynski's two representations. We show how to construct the operator thermodynamic potentials, the expectation values of which provide the familiar thermodynamic variables. Constructing the operator thermodynamic functions and verifying or modifying their relations is a necessary first step in the establishment of a viable thermodynamics theory for quantum systems. We mention noteworthy subtleties for quantum thermodynamics at strong coupling, such as in issues related to energy and entropy, and possible ambiguities of their operator forms. We end by indicating some fruitful pathways for further developments. [View Full-Text](#) / [Download Paper](#)

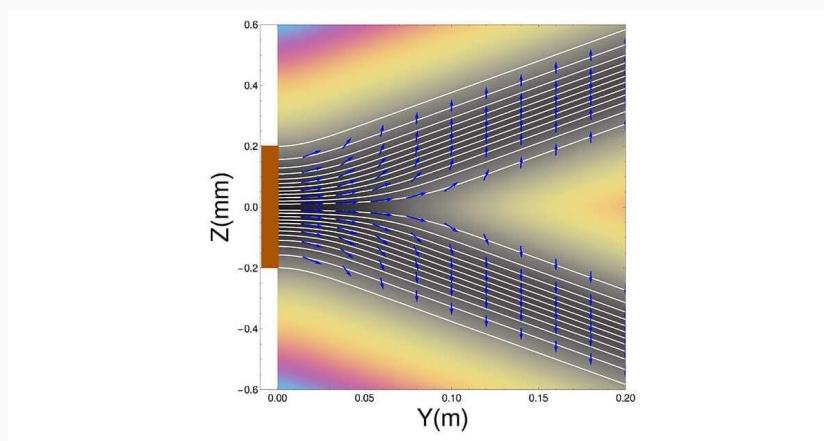
By **Jen-Tsung Hsiang** and **Bei-Lok Hu**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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23/09/2018

**QUANTUM TRAJECTORIES: REAL OR SURREAL?**

The claim of Kocsis et al. to have experimentally determined "photon trajectories" calls for a re-examination of the meaning of "quantum trajectories". We will review the arguments that have been assumed to have established that a trajectory has no meaning in the context of quantum mechanics. We show that the conclusion that the Bohm trajectories should be called "surreal" because they are at "variance with the actual observed track" of a particle is wrong as it is based on a false argument. We also present the results of a numerical investigation of a double Stern-Gerlach experiment which shows clearly the role of the spin within the Bohm formalism and discuss situations where the appearance of the quantum potential is open to direct experimental exploration.

[View-Full-Text / Download Paper](#)**By Basil J. Hiley and Peter Van Reeth**

*This abstract belongs to an article of the Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"*

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**NEWS** 

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**21/07/2015**

## „NATURE“ WORLD VIEW – “METASCIENCE COULD RESCUE THE REPLICATION CRISIS”

“We need a clearer sense of the processes that influence the reliability of new findings”, said psychologist Jonathan Schooler (UC Santa Barbara) in a recent commentary he wrote for “Nature” titled “Metascience Could Rescue the Replication Crisis”. The author, who is also a Science Advisor with the Fetzer Franklin Fund (FFF), describes the decline effect, the reproducibility crisis in science, and the large scale, multi-center effort by the FFF. This multi-year research effort seeks to identify the essential factors leading to the observed decline in the reproducibility of scientific findings. For the article go to:  
<http://www.nature.com/news/metascience-could-rescue-the-replication-crisis-1.16275/>

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## NEWS

18/04/2019

### SCIENCE MAG: INTERVIEW WITH URI MAOZ AT THE 2ND INTERNATIONAL CONFERENCE ON NEUROSCIENCE AND FREE WILL

Science spoke at the [2nd International Conference on Neuroscience and Free Will](#) with project leader Uri Maoz, a psychologist and computational neuroscientist at Chapman, about how the new effort aims to change the future of free will research.

The whole interview is available at <https://www.sciencemag.org>.

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**NEWS** 

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02/07/2015

## SPEAKERS ARE ANNOUNCED FOR “EMERGENT QUANTUM MECHANICS” SYMPOSIUM (EMQM15)

Is the world local or nonlocal? What is the nature of quantum nonlocality? Is the world intrinsically interconnected at the physical level? What is the role of the scientific observer? The Fetzer Franklin Fund (FFF) announces the key note and plenary speakers for its upcoming EmQM15 Symposium on “Emergent Quantum Mechanics”. The Opening Key Note Lecture will be given by Prof. Yakir Aharonov. EmQM15 is the Third International Symposium about Quantum Mechanics based on a “Deeper Level Theory”. The Symposium will take place at the Vienna University of Technology on October 23-25, 2015. Lead organizers Gerhard Grössing (Austrian Institute for Nonlinear Studies, Vienna) and Jan Walleczek (FFF, Phenoscience Laboratories, Berlin) invite the participation of anyone with an interest in (i) the future of quantum mechanics and (ii) how new insights into quantum phenomena may change long-held assumptions about the nature of physical reality. This event is free of charge. For more information about EmQM15 and for registration please go to [www.emqm15.org](http://www.emqm15.org).

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## NEWS

20/09/2018

### SPOOKY ACTION AT A TEMPORAL DISTANCE



Since the discovery of Bell's theorem, the physics community has come to take seriously the possibility that the universe might contain physical processes which are spatially nonlocal, but there has been no such revolution with regard to the possibility of temporally nonlocal processes. In this article, we argue that the assumption of temporal locality is actively limiting progress in the field of quantum foundations. We investigate the origins of the assumption, arguing that it has arisen for historical and pragmatic reasons rather than good scientific ones, then explain why temporal locality is in tension with relativity and review some recent results which cast doubt on its validity. [View Full-Text](#) / [Download Paper](#)

By [Emily Adlam](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

21/07/2015

### STANFORD UNIVERSITY CONFERENCE EXPLORES THE REPRODUCIBILITY CRISIS IN SCIENCE



How to address the current reproducibility crisis in science? The acceptance and impact of breakthrough findings depends on the ability to reproduce these findings by independent investigators. To explore the challenge of reproducibility from a meta-scientific perspective, the Fetzer Franklin Fund (FFF) co-sponsored a conference on scientific integrity and “Best Practices in Science” (BPS) at Stanford University’s Center for Advanced Study in the Behavioral Sciences. The conference was held on June 18-19, 2015. Lead Organizer Jon Krosnick, a social psychologist at Stanford University, is a member also of the FFF multi-center team exploring the so-called “Decline Effect”, and the role of the experimenter agent in science. The other four members of this inter-laboratory research initiative include [Jonathan Schooler](#) (UC Santa Barbara), Leif Nelson (UC Berkeley), Brian Nosek (Center for Open Science, Charlottesville), and [Jan Walleczek](#) (FFF and Phenoscience Laboratories, Berlin). For more information consult the section on [metascience](#) on this website and visit also: <http://bps.stanford.edu/>; <http://centerforopenscience.org/>.

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## NEWS

20/09/2018

### THE MONTEVIDEO INTERPRETATION OF QUANTUM MECHANICS: A SHORT REVIEW

$$(a) \quad 1 < f\tau = \frac{\mu\gamma_1\gamma_2}{\hbar} \frac{\tau}{d^3},$$

$$(b) \quad \Delta x \sim \sqrt{\frac{\hbar T}{m}},$$

$$(c) \quad f \ll |B(\gamma_1 - \gamma_2)|,$$

$$(d) \quad \langle \hat{M} \rangle \sim \exp \left( -6NB^2(\gamma_1 - \gamma_2)^2 T_{\text{Planck}}^{4/3} \tau^{2/3} \right),$$

The Montevideo interpretation of quantum mechanics, which consists of supplementing environmental decoherence with fundamental limitations in measurement stemming from gravity, has been described in several publications. However, some of them appeared before the full picture provided by the interpretation was developed. As such, it can be difficult to get a good understanding via the published literature. Here, we summarize it in a self-contained brief presentation including all its principal elements. [View Full-Text](#) / [Download Paper](#)

**By Rodolfo Gambini and Jorge Pullin**

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

28/08/2018

### THE PHILOSOPHICAL AND SCIENTIFIC METAPHYSICS OF DAVID BOHM



Although David Bohm's interpretation of quantum mechanics is sometimes thought to be a kind of regression towards classical thinking, it is in fact an extremely radical metaphysics of nature. The view goes far beyond the familiar but perennially peculiar non-locality and entanglement of quantum systems. In this paper, a philosophical exploration, I examine three core features of Bohm's metaphysical views, which have been both supported by features of quantum mechanics and integrated into a comprehensive system. These are the holistic nature of the world, the role of a unique kind of information as the ontological basis of the world, and the integration of mentality into this basis as an essential and irreducible aspect of it. [View Full-Text](#) / [Download Paper](#)

By [William Seager](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

**13/01/2020**

### CONFERENCE: THE SCIENCE OF CONSCIOUSNESS 2020 (TUCSON, ARIZONA, USA)

'The Science of Consciousness' ('TSC') is the world's largest and longest-running interdisciplinary conference addressing fundamental questions regarding consciousness, the brain, reality and existence.

Pursuing questions like 'Does consciousness emerge purely from complex computation among brain neurons, or is it an intrinsic feature of the universe?' or 'What can psychedelics tell us about consciousness and reality, and how can they best be used to treat mental and cognitive disorders?', ~700 scientists, philosophers, educators, academicians, students, meditators, artists, interested public and seekers from 50 countries will gather April 13-18, 2020 at Loews Ventana Canyon Resort, a plush ecolodge in the Catalina Mountains outside Tucson, Arizona. The 6-day program will consist of Plenary talk sessions, Workshops (Monday, April 13), Concurrent talk sessions, Posters, Exhibits, Social events and Entertainment in a fun, rigorous environment. Fetzer Franklin Fund is one of the sponsors supporting this conference.

For more information, or for help with registration, please go to  
[www.consciousness.arizona.edu](http://www.consciousness.arizona.edu)

#### Key Facts

**Venue:** Loews Ventana Canyon Resort, 7000 North Resort Drive, Tucson, AZ 85750, United States

**Conference website:** <http://www.consciousness.arizona.edu/>

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## NEWS

26/08/2018

### THE SYMPLECTIC CAMEL AND POINCARÉ SUPERRECURRENCE: OPEN PROBLEMS



Poincaré's Recurrence Theorem implies that any isolated Hamiltonian system evolving in a bounded Universe returns infinitely many times arbitrarily close to its initial phase space configuration. We discuss this and related recurrence properties from the point of view of recent advances in symplectic topology which have not yet reached the Physics community. These properties are closely related to Emergent Quantum Mechanics since they belong to a twilight zone between classical (Hamiltonian) mechanics and its quantization. [View Full-Text](#) / [Download Paper](#)

By [Maurice de Gosson](#)

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## NEWS

**21/07/2015**

### TOP FIVE RANKING BY THE INSTITUTE OF PHYSICS OF EMQM13 CONFERENCE PROCEEDINGS

A Top Five ranking of most frequently downloaded conference proceedings was recognized by the Institute of Physics (IOP) for the EmQM13 Symposium sponsored and co-organized by the Fetzer Franklin Fund (FFF). The proceedings featured the original speaker contributions to EmQM13, the Second Symposium on "Emergent Quantum Mechanics", which was held at the venues of the Austrian Academy of Sciences on October 3-6, 2013. Please obtain an electronic version of the EmQm13 proceedings at the IOP website (Journal of Physics: Conference Series, Vol. 504): <http://iopscience.iop.org/1742-6596/504/1>. For video presentations of all speaker contributions either go to the [event page](#) or go to: [www.emqm13.org](http://www.emqm13.org).

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22/01/2020

**UNDECIDABILITY, UNCOMPUTABILITY, AND UNPREDICTABILITY – NEW ESSAY CONTEST****Essay Contest:****Undecidability, Uncomputability,  
and Unpredictability Essay Contest****FQXi**  
FOUNDAATIONAL QUESTIONS INSTITUTE

Fetzer Franklin Fund and FQXi announce the Undecidability, Uncomputability, and Unpredictability Essay Contest open to submissions through March 16, 2020.

For a brief time in history, it was possible to imagine that a sufficiently advanced intellect could, given sufficient time and resources, in principle understand how to mathematically prove everything that was true. They could discern what math corresponds to physical laws, and use those laws to predict anything that happens before it happens. That time has passed. Gödel's undecidability results (the incompleteness theorems), Turing's proof of non-computable values, the formulation of quantum theory, chaos, and other developments over the past century have shown that there are rigorous arguments limiting what we can prove, compute, and predict. While some connections between these results have come to light, many remain obscure, and the implications are unclear. Are there, for example, real consequences for physics – including quantum mechanics – of undecidability and non-computability? Are there implications for our understanding of the relations between agency, intelligence, mind, and the physical world?

In this essay contest, we open the floor for investigations of such connections, implications, and speculations. We invite rigorous but bold and open-minded investigation of the meaning of these impossibilities for reality, and for us, its residents.

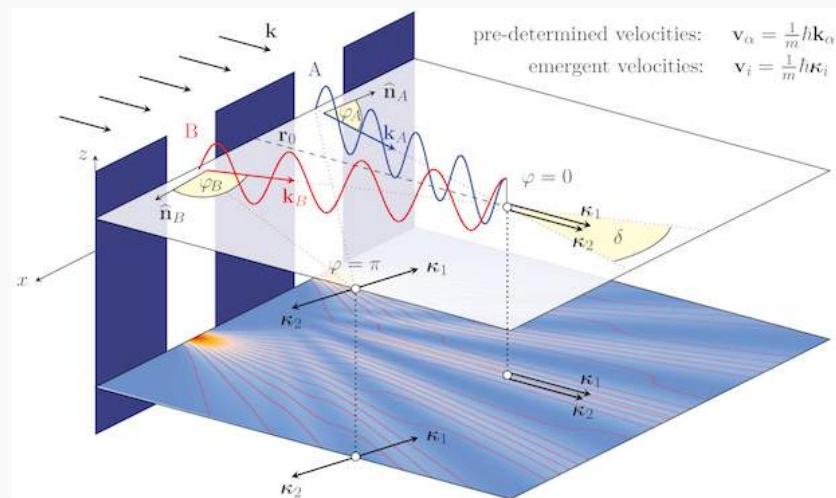
For more information about the contest guidelines (Goals & Intent, Evaluation Criteria, Contest Rules & Procedures, Technicalities & Legalities) please go to  
<https://fqxi.org/community/essay/rules>

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## NEWS

**09/09/2018**

### VACUUM LANDSCAPING: CAUSE OF NONLOCAL INFLUENCES WITHOUT SIGNALING



In the quest for an understanding of nonlocality with respect to an appropriate ontology, we propose a "cosmological solution". We assume that from the beginning of the universe each point in space has been the location of a scalar field representing a zero-point vacuum energy that nonlocally vibrates at a vast range of different frequencies across the whole universe. A quantum, then, is a nonequilibrium steady state in the form of a "bouncer" coupled resonantly to one of those (particle type dependent) frequencies, in remote analogy to the bouncing oil drops on an oscillating oil bath as in Couder's experiments. A major difference to the latter analogy is given by the nonlocal nature of the vacuum oscillations. We show with the examples of double- and n-slit interference that the assumed nonlocality of the distribution functions alone suffices to derive the de Broglie-Bohm guiding equation for N particles with otherwise purely classical means. In our model, no influences from configuration space are required, as everything can be described in 3-space. Importantly, the setting up of an experimental arrangement limits and shapes the forward and osmotic contributions and is described as vacuum landscaping. [View Full-Text](#) / [Download Paper](#)

By [Gerhard Grössing](#), [Siegfried Fussy](#), [Johannes Mesa Pascasio](#) and [Herbert Schwabl](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

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## NEWS

24/09/2018

### WHAT CONSTITUTES EMERGENT QUANTUM REALITY? A COMPLEX SYSTEM EXPLORATION FROM ENTROPIC GRAVITY AND THE UNIVERSAL CONSTANTS

Note the similarity with the entropic gradient in Equation (24). As a result, the gravitational acceleration is very straightforwardly considered as being induced by an informational constituent density gradient also in Equation (19):

$$a_m = -\pi c^2 R_P \frac{\Delta \rho_i}{\Delta R}. \quad (26)$$

For the relativistic space-time constituents interacting through Equation (15), this means that:

$$a_0 \approx -2\pi c^2 R_P \frac{\Delta \rho_i}{\Delta R} = -c^2 \frac{\Delta \rho_r}{\Delta R}. \quad (30)$$

In this work, it is acknowledged that important attempts to devise an emergent quantum (gravity) theory require space-time to be discretized at the Planck scale. It is therefore conjectured that reality is identical to a sub-quantum dynamics of ontological micro-constituents that are connected by a single interaction law. To arrive at a complex system-based toy-model identification of these micro-constituents, two strategies are combined. First, by seeing gravity as an entropic phenomenon and generalizing the dimensional reduction of the associated holographic principle, the universal constants of free space are related to assumed attributes of the micro-constituents. Second, as the effective field dynamics of the micro-constituents must eventually obey Einstein's field equations, a sub-quantum interaction law is derived from a solution of these equations. A Planck-scale origin for thermodynamic black hole characteristics and novel views on entropic gravity theory result from this approach, which eventually provides a different view on quantum gravity and its unification with the fundamental forces.

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By Arno Keppens

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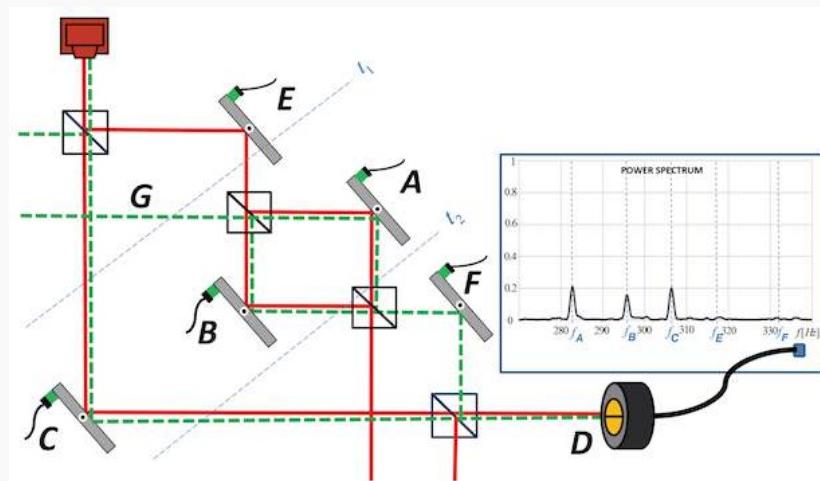
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## NEWS

24/08/2018

### WHEN PHOTONS ARE LYING ABOUT WHERE THEY HAVE BEEN



The history of photons in a nested Mach-Zehnder interferometer with an inserted Dove prism is analyzed. It is argued that the Dove prism does not change the past of the photon. Alonso and Jordan correctly point out that an experiment by Danan et al. demonstrating the past of the photon in a nested interferometer will show different results when the Dove prism is inserted. The reason, however, is not that the past is changed, but that the experimental demonstration becomes incorrect. The explanation of a signal from the place in which the photon was (almost) not present is given. Bohmian trajectory of the photon is specified. [View Full Text](#) / [Download Paper](#)

By [Lev Vaidman](#) and [Izumi Tsutsui](#)

*This abstract belongs to an article of the [Special Issue "Emergent Quantum Mechanics - David Bohm Centennial Perspectives"](#)*

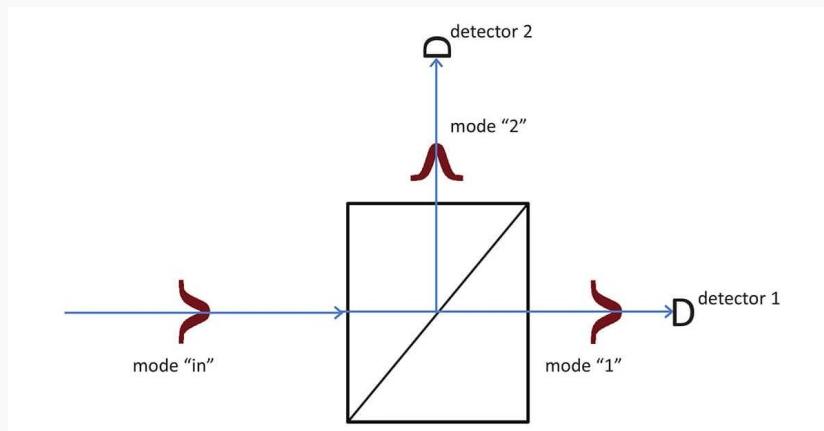
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## NEWS

24/09/2018

### WHY BOHMIAN MECHANICS? ONE- AND TWO-TIME POSITION MEASUREMENTS, BELL INEQUALITIES, PHILOSOPHY, AND PHYSICS



In Bohmian mechanics, particles follow continuous trajectories, so two-time position correlations have been well defined. However, Bohmian mechanics predicts the violation of Bell inequalities. Motivated by this fact, we investigate position measurements in Bohmian mechanics by coupling the particles to macroscopic pointers. This explains the violation of Bell inequalities despite two-time position correlations. We relate this fact to so-called surrealistic trajectories that, in our model, correspond to slowly moving pointers. Next, we emphasize that Bohmian mechanics, which does not distinguish between microscopic and macroscopic systems, implies that the quantum weirdness of quantum physics also shows up at the macro-scale. Finally, we discuss the fact that Bohmian mechanics is attractive to philosophers but not so much to physicists and argue that the Bohmian community is responsible for the latter.

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By [Nicolas Gisin](#)

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